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A SIMPLE WAY TO INCREASE CROP YIELDS

Methods Followed by Farmers of the Coastal Plain Section
of the Central Atlantic States in Building Up Soil Fertility

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THE SOILS of the coastal plain section of the Central Atlantic States, as a rule, are light in character, have been farmed for generations, and need first of all a liberal supply of organic matter. This need should be met by growing such legumes as crimson clover, cowpeas, soy beans, red clover, and hairy vetch. Rye, buckwheat, and the grasses are also valuable in this connection.

Commercial fertilizer and lime should be used freely when necessary to stimulate the growth of these soil-improving crops.

By arranging the cropping system to include one or more legumes that supply the land with nitrogen and humus, crop yields have been greatly increased on many farms scattered throughout this region. The systems followed on a few of the more successful of these farms are described in detail in the following pages.

A SIMPLE WAY TO INCREASE CROP YIELDS.

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THE COASTAL PLAIN section of New Jersey, Maryland, Delaware, and Virginia constitutes one of the oldest farming regions in the Central Atlantic States. Much of the cleared land has been farmed continuously since the region was settled more than two hundred years ago. As a rule, the cropping systems and methods of farming of the past have not provided for maintaining fertility, and in some localities a relatively large part of the farm lands do not produce yields large enough to make farming profitable. During more recent years, however, more attention has been given to the improvement of the farm lands of this region, and as a result much of the soil has been built up in fertility and many farms are now producing more than double the crop yields they did before.

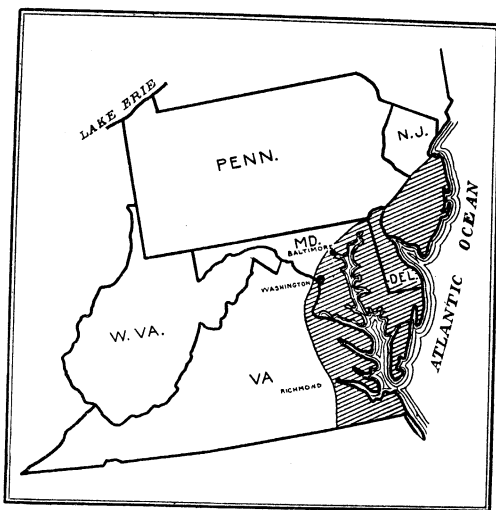


FIG. 1.—Map of Coastal Plain section of central Atlantic States.

ECONOMIC CONDITIONS.

The coastal plain section of the Central Atlantic States is especially well located geographically with reference to several of the important centers of population that consume large quantities of farm products. A market is therefore within easy shipping distance

for the great variety of crop and live-stock products to which the conditions of climate and soil of this region are so well adapted.

Transportation is provided by both rail and water. In a large part of the region railroads, and in many cases the main lines, connect directly with the large cities, which permits the marketing of the most perishable products without difficulty. Chesapeake Bay and its tributaries, which in many instances are navigable some distance inland, afford water transportation to those parts of the region not reached by railroad.

The farm land of this region is made up of a great variety of soils, varying from sands and sandy loams with light subsoil to silts and silt loams and clay loams with heavier subsoils. The natural productiveness of these soils varies greatly. Some need special treatment at the start in order to make them productive; others are productive for a few years, but are soon depleted unless provisions are made for the maintenance of fertility; while other classes of soil have been farmed continuously for a great many years and are still producing good crops.

This variation in character of soil in different parts of the region and the demand for different farm products by the cities have resulted in the production of a wide diversity of crops. Farms located on the lighter, sandier soils are devoted mostly to the growing of truck and small fruits, while the farms on the heavier land produce crops of corn, wheat, and hay, and live-stock products. The combined effect, therefore, of soil conditions and market demands has been very largely responsible for the development of types of farming that do not include much live stock, but go more into the production of cash crops for sale on the market. This development has resulted in the use of large quantities of commercial fertilizer, which, in a measure, has retarded the development of other important methods of soil maintenance.

As a rule, comparatively little attention in the past has been given to methods of soil management by the farmers of this region. Even now, in many localities, legumes are not generally grown and winter cover crops are practically unknown. In many cases the same crop has been grown year after year on the same land with little or no provision for maintaining fertility other than the use of small amounts of commercial fertilizer. This lack of attention on the part of the farmer has resulted in poor yields and an unproductive condition of the soil on many farms of the region.

At the present time, then, the situation with respect to crop production here may be stated as follows: The stronger and naturally more fertile soils are still producing profitable crops and will probably continue to do so for many years. Other soils that have been built up by improved methods of soil management to a high state of

fertility are also productive. By far the greater portion of the region, however, is returning crop yields that are responsible for placing many farms on the border line between a profitable and a losing business. There is also a considerable amount of land that is decidedly unproductive and some that for this reason is not farmed at all. Since crop yield is one of the more important single factors in determining the profits from farming, it is of the utmost importance to the agriculture of the region that the fertility of these poorer producing lands be improved.

The changes in economic conditions demand greater returns than ever. The cost of production has increased; farm labor is scarce and wages are high; equipment is expensive and the price of land has gone up. The price received for farm products until recently has not increased in the same proportion, so that low yields are distinctly unprofitable. Larger yields are therefore of the utmost importance in a large part of the coastal plain section of the Central Atlantic States. Most of this land can be made more productive by a moderate outlay of time and money if the proper methods of management are carried out. The first step toward the solution of the problem of these poor lands is perhaps the most difficult—the building up of soil fertility to a point where it will produce yields large enough to put farming on a paying basis. Fortunately, we have many examples of farms located in this region that have been made more productive by the farmers adopting improved methods of management that may well serve as a guide in the solution of the problem of building up soil fertility and obtaining better crop yields on other poor farms.

IMPORTANT FACTORS IN SOIL IMPROVEMENT.

On account of the differences in the character of the soil and the great variety of crops that are grown in this region, there is much diversity in farm practice, not only in the use of fertilizers and methods of tillage but also in the methods of soil improvement. For example, some farmers depend chiefly on the manure from live stock to make their land productive, others depend on the sod remaining from grass and clover crops with the use of commercial fertilizers, others grow legumes to turn under as green manure, while still others use a combination of one or more of these methods. There is one outstanding feature, however, in all of these different methods of building up land, the fact that in every case where the fertility of the soil has been built up and crop yields materially increased large quantities of vegetable matter have been added to the soil in one form or another.

Commercial fertilizers and tillage practices also play an important part in crop production, but the general results that have been obtained indicate that humus is one of the most important factors in

the improvement of the soil of this region and that crop production depends very largely upon the quantity of decayed vegetable matter present. On some of the poorer, low-yielding land, for example, a good growth of crimson clover turned under doubles the yield of the succeeding crops. There are many instances where farmers have plowed under three crops of crimson clover in succession and have brought the land up from a condition where it produced only 15 bushels of corn per acre to a point where it produced more than 50 bushels per acre. This indicates that as the organic matter is increased in these soils yields increase also.

The presence of organic matter benefits these lands in several ways. It increases the bacterial activity so essential to crop production. Water is absorbed more readily during heavy rains, which lessens the danger from washing. Soils well supplied with organic matter are also more retentive of moisture, remain more friable, are easier to work, and are less likely to become hard or form a crust after rains. The chief source of nitrogen in the soil is from the breaking down and decay of organic matter present. Since nitrogen is one of the most expensive fertilizers that the farmer has to buy, it is very important that every effort be made to supply this element by growing legumes or providing humus in other forms.

The big problem in connection with the improvement of farm land in this region is to get organic matter into the soil and to do it economically. In the farm practice of the region there are three principal sources from which humus is usually supplied—farm manure, roots and stubbles left from crops, and green crops turned under.

FARM MANURES.

Farm manure is a most valuable source of fertility on many of the farms of this region. In addition to supplying considerable nitrogen, some phosphoric acid, and potash, it is also an important source of humus. In parts of this region where the type of farming includes live stock, the manure from the animals and the sod remaining from the clover and grass crops are the chief reliance for maintaining the supply of organic matter in the soil. On the heavier soils, and especially on live-stock farms where a large part of the land is kept in sod, the manure produced is usually sufficient to maintain the organic matter necessary for good crop production. But on some of the lighter lands it is difficult to maintain the normal supply of organic matter even on farms heavily stocked with animals and where all crops are fed. On the lighter lands especially it is necessary not only to use all the available manure but still further to increase the organic matter in the soil by crop residues and green crops turned under.

The importance of supplementing the farm manure with organic matter from other sources is well illustrated by the results obtained on a dairy farm located on light sandy land in Anne Arundel County, Md. The crops grown were corn and cowpeas in a two-year rotation. Two hundred pounds of acid phosphate per acre were applied to each crop. In addition to the roughage produced by the corn and cowpeas, grain was bought and fed to the cows. In spite of the fact that all of the manure thus produced by the cows and work stock was returned to the land, the crop yield steadily declined until the cropping system was rearranged to provide a greater quantity of organic matter in the soil. This was accomplished by sowing crimson clover in the corn and plowing it under for the cowpeas.



FIG. 2.—Sixty bushels of corn per acre and a large amount of organic matter to be returned to the soil.

CROP RESIDUES.

The roots and stubble left in the soil after crops are harvested constitute a very important source of organic matter. The amount of this material left from such crops as corn and wheat when harvested in the usual way is not large, but where systems of management are followed which leave practically the entire crop on the field the organic matter thus added is very much greater. The practice of pasturing off crops with live stock is a very economical way of removing the crops and adding large quantities of organic matter to the soil. Figure 2 shows the possibilities of this method.

The corn crop shown in this illustration was husked from the stalk and live stock was turned in to pasture on the peas and corn-stalks. This is a very effective method of building up soil through the addition of organic matter.

Supplying organic matter by methods which turn back as great a crop of residue as possible ordinarily does not receive sufficient attention on the average farm of the region. In planning a cropping system the amount of organic matter that will be supplied to the land should be carefully considered and every opportunity to increase this supply should be utilized. The cropping system that does not provide for maintaining an abundance of organic matter in the soil is of little value in building up fertility. Merely alternating crops is not sufficient. Hay and pasture land should be plowed while there is still a good sod. Weeds, cornstalks, straw, and other material of this kind are valuable sources of organic matter. In addition to this, the cropping system should provide either for the pasturing off of crops with live stock or the turning under of green crops regularly in the rotation.

IMPORTANT CROPS FOR SOIL IMPROVEMENT.

The type of farming usually followed in the coastal plain section does not include much live stock aside from the necessary work animals. As a result, there is very little manure available on the average farm, and crops grown for the purpose of supplying organic matter must be relied upon to keep the soil in a productive condition. Perhaps the most rapid progress in the improvement of depleted farm lands in this section is attributable to this method of procedure. Especially is this true where the farmers have made provision in their cropping systems to plow under some green crop at regular intervals. In some instances it has been necessary to produce several green manure crops and plow them under before sufficient organic matter could be accumulated to produce yields that would be at all profitable. This is somewhat expensive, but in extreme cases of soil depletion it is doubtless good practice.

In planning to use green-manure crops as a means of soil improvement it is of distinct advantage to use legumes in so far as possible. In addition to adding the organic matter, which is of so great importance, these crops supply large quantities of nitrogen to the soil. As has been pointed out, nitrogen is the most expensive element which is purchased in the form of commercial fertilizers. If legumes are grown regularly and plowed under on the different fields of the farm, the nitrogen required for the growth of the other crops will be supplied and much money may be saved which would otherwise have been expended on fertilizers.

COWPEAS.

Cowpeas are one of the best-known crops in the area and one of the first to be used for the purpose of soil improvement. This crop possesses several advantages over most others. It will probably grow on poorer soil and give better results in extreme cases of soil depletion than any other crop that is at present used in the

process of soil improvement in the area. It is advisable, generally, to begin building up the soil first by growing cowpeas, because this crop can be grown with very simple treatment and little expense in preparation. Cowpeas do well without lime or inoculation, and respond readily to the application of small amounts of fertilizer. (For full discussion of methods of growing cowpeas see Farmers' Bulletin 1148.)

Cowpeas are grown in a number of ways and for a number of purposes, but however used they are valuable in the improvement of the soil. Occasionally the crop is plowed under, but it is more generally grown for hay. In some instances seed is produced and sold as a cash crop. Another plan which offers considerable opportunity for soil improvement is to sow cowpeas in the corn at the last cultivation. Grown in these various ways, cowpeas are capable of improving the land up to a point where a wider variation of crops can be produced.

CRIMSON CLOVER.

Throughout the region crimson clover stands out as one of the more valuable crops for soil improvement. In addition to being an excellent crop to plow under as a green manure, it is also valuable for early spring grazing and for hay. Sown in the late summer or early fall, it occupies the land during the winter and serves as a cover crop, and protects the soil from washing and leaching through the fall, winter, and spring seasons, which is a matter of very great importance in this region, where the winters are generally mild, with frequent rains. The expense of seeding is usually but little more than the cost of the seed, and many farmers are now growing their own seed.

Crimson clover can be grown in this section in several different ways. It may be seeded alone in August and September, or in the corn at the last cultivation. It is common practice also to sow it in July with a nurse crop, usually with buckwheat.

In beginning to improve the poorer land in the coastal plain section cowpeas should be grown on the land before attempting to get a stand of crimson clover. The beneficial influence of the cowpeas does much to insure success with the crimson clover crop. The application of from 200 to 300 pounds of acid phosphate per acre is likewise of great importance in starting crimson clover on poor land. In all cases the seed should be covered lightly instead of sowing on the surface and trusting to rains to effect a covering. Artificial inoculation is also an important item which should not be omitted. (For a full discussion of the general methods of growing and utilizing crimson clover, see Farmers' Bulletins 579 and 1142.)

Until the soil is built up slightly and the few special requirements just mentioned are complied with, it is more difficult to grow crimson clover than it is to grow cowpeas, but the great value of crimson clover and the place in the cropping system which it fills, as cowpeas and

some of the other legumes can not, make it highly important that crimson clover be made one of the crops grown regularly in the cropping system. Figure 3 shows how luxuriantly crimson clover grows on some of the poorer lands of this section after some of the requirements of the crop have been met.

SOY BEANS.

The soy-bean crop is not grown as extensively in the region as it should be. While similar to cowpeas in regard to growing season and the place occupied in the cropping system, soy beans as a rule are a more profitable crop than cowpeas, except on very poor land. For starting the improvement of very poor land cowpeas have given better results than any other crop yet tried. On land where soy beans have not previously been grown, artificial inoculation is usually necessary

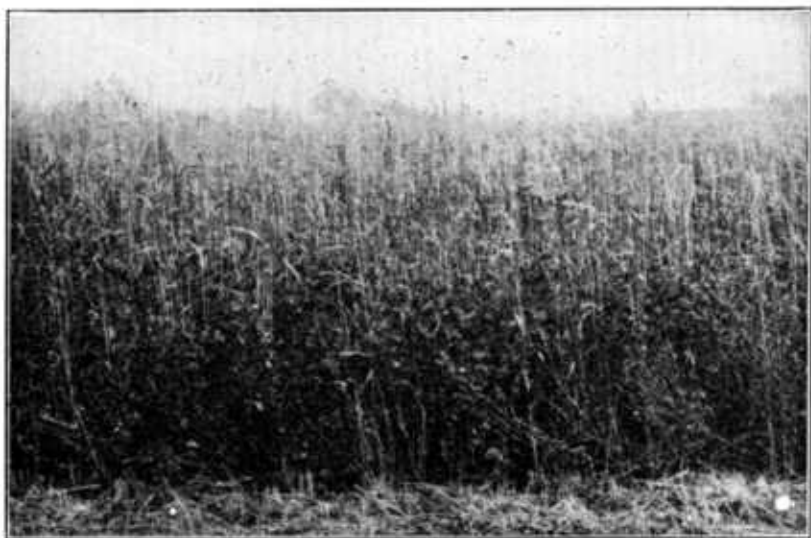


FIG. 3.—Crimson clover is one of the most valuable crops grown in the area.

for best results. Once the land becomes thoroughly inoculated, which it usually does the second successive time they are grown on the same land, the yield of both seed and forage is usually greater than the yield from cowpeas.

Soy beans are especially valuable for feeding farm animals. The yield of seed is usually double that of cowpeas, and the hay is of equally good quality and easier to cure than cowpea hay. Soy beans are much used as a crop for hogging-down, either when sown alone or with corn. When cut and stacked this crop has given especially good results as a winter feed for hogs in connection with a light ration of corn. The value of soy beans, both as a feed crop and for the improvement of soil, warrants a much greater acreage than is at present grown in this section. (For full information on this crop, see Farmers' Bulletins 886 and 973.)

VETCH.

Hairy vetch is well adapted to the soil and climatic conditions of the region, but on account of the lack of information on the methods of growing and use of the crop it is not grown generally. The marked success by a great many farmers who grow vetch regularly warrants a more general use of this crop for soil improvement in this region. Sown with grain in the fall, it has the advantage of being more hardy than crimson clover and can therefore be sown much later in the season without danger of winter-killing. This crop, like crimson clover, occupies the land during the fall, winter, and spring, acting as a cover, and conserves soil fertility. The mixture of vetch and grain is usually cut for hay in May, depending on

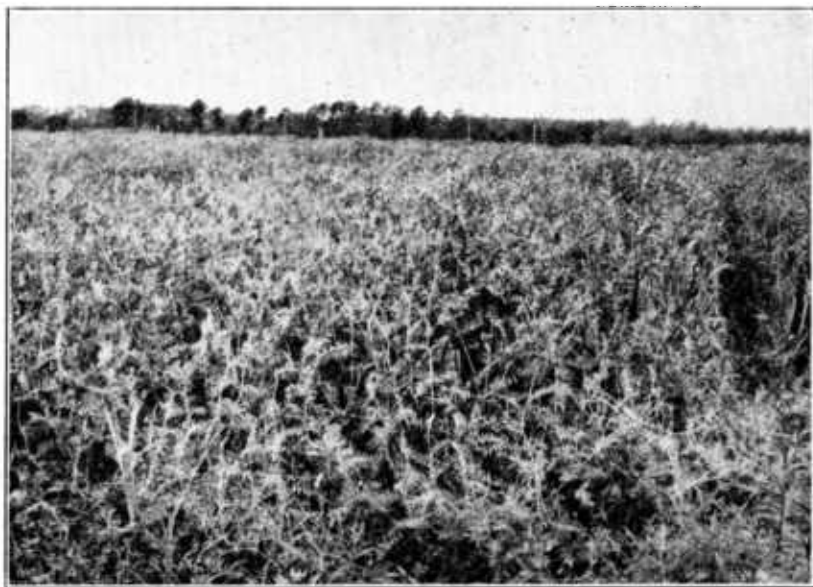


FIG. 4.—An excellent growth of wheat and vetch for hay and soil improvement.

the grain with which it is sown. After the hay is cut the land can be planted to corn, cowpeas, soy beans, or tomatoes. This makes the crop a valuable addition to the ordinary cropping system of the region. As shown in figure 4, the crop produces a good growth of hay and a large amount of organic matter to be plowed under.

The methods of growing vetch are comparatively simple. The seed is usually mixed with grain and sown with a drill at the rate of about 30 pounds of vetch to one bushel of wheat or rye per acre. It has been the usual practice to sow this crop without paying much attention to inoculation. In some parts of the region it is advisable to inoculate the seed in order to insure a good growth. (Complete details of growing this crop are found in Farmers' Bulletin 967.)

RED CLOVER.

On the lighter soils of the area red clover is not commonly grown, but on the heavier types, where the cropping system usually includes small grain, red clover is of considerable importance. Red clover occupies a very different position in the cropping system from that of any of the crops referred to above. It is usually sown in the spring on small grain and comes to maturity the following year, being used either for hay or pasture. In many instances crimson clover is used in the same cropping system with ordinary red clover, but on land that produces red clover without difficulty crimson clover is not grown to any great extent. Light applications of lime have been found to be very beneficial in promoting the growth of red clover on the heavier soils of this region. The application of lime and an increase in organic matter usually makes it possible to grow red clover successfully on many of the lighter soils. (For further information regarding this crop, see Farmers' Bulletin 1339.)

RYE.

This crop is used in many different ways by farmers of this region. It is especially well adapted to use as a winter cover crop for the reason that it can be sown at almost any time during the fall and early winter without danger of winter-killing. As soon as growth starts in the spring it can be pastured for 4 to 6 weeks and then allowed to grow up for turning under as a green manure. The practice of sowing a mixture of rye and crimson clover is followed in many instances and usually gives better results on thin land than either of these crops sown alone. With a crop such as rye always at hand and seed at a reasonable price, there is little excuse for any of the farm land in this region to be without a cover during the winter months.

BUCKWHEAT.

In the improvement of the soils of this area buckwheat is used to great advantage. It is a convenient crop to manage, as it can be sown at almost any time during the growing season and is ready to turn under in about eight weeks after planting. The short growing period required allows buckwheat to be grown after the removal of other crops, and also to be sown ahead of and turned under before late planted crops need be planted. Not being a legume, the main advantage of buckwheat in connection with soil improvement is the addition of organic matter. In many parts of the region the usual practice is to sow buckwheat and crimson clover in July. The buckwheat is allowed to mature and is harvested for the grain, and the crimson clover then has full possession of the land for the remainder of the year. This practice reduces the expense of sowing the crimson clover, in that the buckwheat crop usually is sufficient to pay the expense of the entire operation. The fact that the crimson clover is sown early and makes a good growth before cold weather sets in is a distinct advantage from the soil-improvement standpoint.

THE USE OF FERTILIZERS.

The farmers of the region who are getting the best results from the use of fertilizers, especially those who are growing general farm crops, are maintaining a high percentage of organic matter in the soil and fertilizing from the standpoint of the needs of the soil in general rather than the fertilizer requirements of the individual crops. Except for potatoes and truck crops, it is wiser economy to use commercial fertilizers in a definite plan of more permanent soil improvement rather than to make light applications principally for the purpose of stimulating the one crop to which it is applied. It is doubtless good business practice to apply fertilizers to a crop and thus increase the production over and above the cost of the fertilizers and the extra labor, but it is still better to accomplish this in such a manner as to effect a more permanent improvement of the soil, which will serve to benefit several crops in succeeding seasons.

The soils of the coastal plain of the Central Atlantic States need nitrogen and humus first of all. The full effect of fertilizers can not be realized on the average soil of the region until this need has been met. After this the application of phosphorus is of great importance and, on the lighter soils especially, the application of potash is distinctly beneficial. The nitrogen is most economically supplied by growing legumes and the turning under of crops. Phosphorus is usually supplied in the form of acid phosphate. For general purposes potash is best supplied through the use of muriate of potash or kainit. Under normal conditions, if sufficient attention is given to maintaining the nitrogen supply in the soil, most satisfactory results are obtained by the use of a fertilizer containing both phosphorus and potash. Such a fertilizer can either be purchased on the market or made on the farm by a process of home mixing.

The fertilizer practice that has given best results on the farms of this region follows the general plan of applying the fertilizer to the crop that is grown especially for soil improvement. Two or three hundred pounds of acid phosphate, for instance, applied to crimson clover that is to be turned under for corn gives much better returns under the average soil conditions of the region than the same amount applied to the corn crop directly. Many of the best farmers are now following the practice of applying the fertilizer to the legumes and grass crops that are grown to supply the nitrogen and organic matter necessary to the building up and maintenance of fertility in the soil. The same holds good in the application of manure. Manure applied on grass land one or two years in advance of the time it is plowed for corn increases the growth of grass, makes more hay and pasture, and a better sod, and hence more organic matter to be plowed under. Such a process is usually better

and the effect more lasting than to apply the manure during the preparation of the land for the corn crop.

In addition to the fertilizing elements which are used, the soils of the coastal plain region quite generally need lime. Lime is especially beneficial in growing red clover, alfalfa, and vetch. Its effect is likewise good on crimson clover, but is not an absolute necessity. Soy beans and cowpeas usually grow well on most of these soils without the application of lime. While an application of lime is generally beneficial in the growing of legumes and assists in the improvement of the soil, it is often difficult to tell whether lime or organic matter is needed most. In numerous instances the beneficial effects which are attributed to lime on especially poor soils are secured with equal effectiveness by adding large quantities of organic matter. In general farm practice in the region it is better to begin with the growing of such legumes as thrive on extremely poor soils and first build up the organic matter and nitrogen by plowing these crops under. In many instances it is found that a profitable system of farming can be established and clover and such crops as had refused to grow satisfactorily can be grown to good advantage by incorporating humus without the application of lime. If, however, after materially increasing the organic matter in the soil by the use of such crops as crimson clover, soy beans, rye, and buckwheat, the need of lime is indicated, it should be supplied by applying ground limestone or ground oyster shells. The test by which the farmer can determine whether his land needs lime is to lime a small part of a field and see if it increases the growth of his soil-improving crops, especially the clovers and grasses.

CROPPING SYSTEMS.

Comparatively few farmers of the coastal plain region in the Central Atlantic States follow a definite crop rotation. While a fixed rotation is in many respects very desirable from the standpoint of soil improvement, it is not absolutely necessary and in many cases not desirable. Most farmers prefer to follow a cropping system that is more or less flexible so that a shift can be made in the order of cropping when a change in prices or variation of seasons should make a change necessary.

In beginning the improvement of land it is preferable generally to start with a more or less definite succession of crops which may later be changed to a cropping system more suited to the type of farming which is being followed. On the poorer lands the best results are obtained by starting with a system of cropping which is extreme in the matter of growing crops for the express purpose of increasing the organic matter in the soil. The following is a good example:

First year-----Cowpeas followed by rye.
 Second year-----Cowpeas followed by crimson clover.
 Third year-----Corn followed by crimson clover.

In the first year of this plan the cowpeas are plowed under and rye is sown in the fall. The rye is allowed to grow until about May 1 of the next spring when it is plowed under in preparation for the cowpea crop of the second year. The cowpeas of the second year may be either plowed under or cut for hay, the former method being preferable, as it will still further hasten the soil improvement. In the fall of the second year crimson clover is sown for the first time. Generally, by this time the soil has been sufficiently improved so that by the use of some fertilizer a reasonably good stand of crimson clover can be obtained. (See Farmers' Bulletin 1142.) The crimson clover crop is permitted to grow until about May 1 of the third year when it is plowed in preparation for the corn crop. It is advisable, also, at the last cultivation of the corn crop of the third year to sow crimson clover for hay or to be plowed under the next season in preparation for other crops. The process of soil improvement by this plan of cropping may be made still more effective by applying 200 to 300 pounds of commercial fertilizer per acre on the cowpeas.

On lands which are not so extremely run down, which are still producing fair crops of corn, such radical measures will not be necessary. In many cases a legume or other humus-forming crop can be included in the cropping system without much extra expense, and at the same time greatly improve the fertility of the soil. Under some conditions—as, for instance, on the farms of the region that grow a variety of small fruit and truck crops—it is desirable to grow the same crop continuously on the same land. This is especially true of corn. There are a number of examples where this is being done successfully by the following plan of cropping:

First year-----Corn with crimson clover sown at last working.

Second year-----Crimson clover turned under and corn again planted.
Crimson clover sown at last working.

Following years-----Repetition of second year.

Under ordinary conditions the yields of corn can not be maintained continuously one year after another on the same land, but with this system, especially with the application of small amounts of fertilizers each year, the yields are being maintained and even increased. By plowing down a crop of crimson clover each year the supply of organic matter is maintained at a high point, and corn can be grown by this system continuously so long as root lice or corn diseases do not make it impracticable. If this happens, it becomes necessary to grow other crops for a few years, after which the old process can generally be repeated for a number of years on the same land. In this, as in all other cropping systems in successful operation in the region, one of the most important features is keeping up a liberal supply of organic matter.

A system of farming that has maintained crop yields on the farms of a large estate in eastern Maryland is described in Farmers' Bulletin 437. The records kept by the estate show that crop yields are about the same now as they were 30 years ago—corn, 30 bushels;

wheat, 17 bushels; and clover hay $1\frac{1}{2}$ tons per acre. These yields are not large, but the fact that they have been maintained for so long a period in a section of country where yields of the same crops on adjoining farms are very much lower is of interest. The soil varies from a sandy loam to a clay loam. The crop rotation practiced is:

- (1) Corn.
- (2) Wheat.
- (3) Clover for hay and pasture.
- (4) Wheat.
- (5) Clover for hay and pasture.

All of the wheat and about three-quarters of the corn grown are sold. The hay and one-quarter of the corn are fed, and the corn stover and wheat straw are utilized as feed and bedding, and the manure returned to the land. The manure is spread on the clover sod and turned under for corn. Each wheat crop is fertilized with commercial fertilizer analyzing 2 per cent nitrogen, 8 per cent phosphoric acid, and 2 per cent potash, at the rate of 300 pounds per acre.

The essential difference between the system of farming on these farms and others of the community is not so much in the fertilizer used as in the rotation and disposition of the crops—a five-field system with two of the fields in clover each year as against a five-field system with one field in clover each year. The clover provides a large amount of nitrogen and humus, so much needed in these soils. The system of renting on these farms encourages the renter to keep live stock and results in all the hay, straw, and corn stover, and part of the corn being fed on the farms and the manure returned to the land.

The production of small fruit and truck crops throughout much of the region necessarily makes the cropping system on many farms more or less irregular. But even on farms devoted largely to the growth of truck and small fruits provision must be made for supplying organic matter to the soil if yields are to be maintained. Organic matter can usually be supplied in such cases by growing winter cover-crops of crimson clover, rye, or vetch. These cover crops can be sown after such crops as potatoes, cantaloupes, tomatoes, and also in standing corn to good advantage. The following four-year rotation, which provides for growing feed for live stock and also some wheat and truck crops for sale, is well adapted to much of this region and will rapidly improve the land:

- First year.....Corn. Cowpeas sown at last working of the corn to be disked in for wheat.
- Second year.....Wheat. Red clover sown on the wheat in early spring.
- Third year.....Clover cut for hay.
- Fourth year.....One-half in tomatoes, followed by crimson clover.
One-half in potatoes, followed by crimson clover.

Cowpeas are sown in the standing corn at the last working and after the corn is cut the peas are disked in for wheat. If manure is available it should be used as a top dressing on the wheat during the

winter and spring before the red clover is sown. This practice insures a good catch of clover. The following year, or the third year of the rotation, the clover is cut for hay. This leaves a good red clover sod that can be plowed in the fall for early potatoes and tomatoes the next spring, or the fourth year of the rotation. After these crops are harvested crimson clover is sown to be turned under the following spring for corn. This rotation not only provides an abundance of organic matter and nitrogen, which keeps the land in a productive condition, but also gives a fairly even distribution of both man and horse labor.

Numerous other cropping systems are in use in the region, some of which are quite effective in building up and maintaining crop production, but these examples illustrate some of the more important features to be considered in formulating cropping systems which are suited, in whole or in part, to most general farms of the area. In addition to the effectiveness of the cropping system the question of financial returns must be considered, as well as the conditions of the individual farm and the finances of the individual farmer.

PRACTICAL MEASURES.

Building up the fertility of the soil is an economic problem as well as an agricultural problem and must have the most careful consideration from this standpoint. Expenditures must be justified by the increase in crop yield either at once or at some time in the near future if the enterprise is to be successful. The kind of crop that is grown and the price received are important factors, since these affect the margin of profit and consequently the amount of money available for improvement.

The rate at which this improvement is to be made must be governed to a certain extent by the amount of capital available for the purpose. With the necessary capital available, the improvement may be carried on rapidly and the soil built up in a comparatively short time. With little or no capital available more time is necessary and the improvement must be brought about gradually. The latter course has its advantages in that there is more time to become familiar with important details, and there is also less danger from losses by putting more money into the soil than returns will warrant, which may occur when the improvement is brought about rapidly.

In this connection, also, the type of farming should be made to conform to the conditions on the individual farm. For the man with small capital, crop farming is a much more simple and more desirable type, for a few years, at least, than live-stock farming. A few cash crops well selected will generally return a reasonable income with less investment than is required for live-stock farming. There is an advantage, however, in keeping enough live stock to utilize feed that might otherwise be wasted, the manure being returned to the land.

All the real advantage, however, of keeping live stock for the manure alone can easily be gained by the use of small amounts of fertilizer and the plowing under of green crops. In starting to improve farm land in this region the tendency to rush into live-stock farming before conditions warrant the change should be studiously avoided. It is the part of wisdom to increase the live stock gradually as the soil is built up to a point where an abundance of feed can be produced easily, and as sufficient capital is accumulated to purchase fences and live-stock equipment. But in the beginning and for a considerable time thereafter crop farming and the sale of cash crops has a decided advantage in its simplicity of operation and quicker and surer returns.



FIG. 5.—Yield too low to pay the labor, much less a profit.

The selection of crops for sale should be based on the experience of the community, taking into account, conditions on the individual farm with reference to character of soil, labor supply and other factors that affect the choice of crops. Whatever the choice of crops may be, whether truck crops and small fruits that require heavy applications of commercial fertilizer or hay and grain not so heavily fertilized, it will be advisable to include clovers and other soil-building legumes in the cropping system in order to supply nitrogen and organic matter to the soil.

The excellent results obtained by many farmers who have increased the yields of their crops by making the land more fertile through the use of a system of cropping that provides for the growing of legumes or other crops which keep the soil well supplied with nitrogen and organic matter should be of special interest to a large number of farmers in the region.

An extra effort should be made to keep the soil well supplied with organic matter by arranging the cropping system so as to provide for the growing of legumes and other crops, especially winter legumes, which may serve as a cover for the land during the winter and not only prevent the loss of any fertility but actually add to the soil by the accumulation of nitrogen and organic matter which improves the physical condition of the land and lessens the need for commercial fertilizers and lime. For this purpose crimson clover is by far the most important winter legume grown in the region. Hairy vetch and rye are also good winter crops, while cowpeas, soy beans, and buckwheat are excellent summer crops for soil improvement and also for grain and forage. The ordinary red clover has long been grown in



FIG. 6.—Crimson clover has increased the yield of corn from 12 bushels to 50 bushels per acre in five years.

regular rotations with small grains for hay and soil improvement, but more attention should be given to securing a good stand and vigorous growth of this important crop.

EXAMPLES OF SOIL IMPROVEMENT.

In the following pages a few concrete examples will be given to illustrate more fully some of the valuable work that has been done in all parts of the north coastal plain region by enterprising farmers. While a large number of these examples could be given, only a few which are representative of the simplest as well as the highest type of work of this kind will be cited.

A CORN FARM.

On one farm in Caroline County, Va., the regular practice had been to grow corn on the land one year in three and to allow each field to "rest" during the other two years. The "resting" process was to allow weeds and trash to grow up and thus accumulate sufficient fertility for another crop of corn. With this system of cropping the yield of corn ranged generally from 15 to 18 bushels. Figure 5 shows the crop growth on a part of the farm which was still under this system.

The improvement of the soil on this farm began first by planting one of the poorest fields to cowpeas. The cowpeas were cut for hay and the stubble disked and seeded to crimson clover. The follow-



Fig. 7.—Less than 100 pounds of lint cotton per acre. This land needs organic matter.

ing spring the crimson clover crop was turned under and the field planted to corn. At the last working of the corn, crimson clover was again sown. The following spring the same process was repeated by turning under the crimson clover and planting corn again on the same land. This practice was continued for five years. The third year the yield of corn was about 40 bushels to the acre and the fifth year the crop made a yield of 50 bushels to the acre. Figure 6 shows the change that has taken place under this method of cropping.

Up to the time of the change in the cropping system, it had been the regular practice to apply 200 pounds of 16 per cent acid phosphate per acre to each crop grown. Under that system, however, crop yields could not be maintained. After the change in cropping system, the same amount of acid phosphate was applied each year

to the corn crop. The only real change in method was to grow first a crop of cowpeas and after that to turn under a catch crop of crimson clover in preparation for the corn each year. The improvement in soil conditions is further evident from the fact that after the fifth consecutive corn crop, wheat was sown and a yield of 22 bushels per acre was harvested. While these yields are not extremely large, it was possible by simple methods and with comparatively small expense to increase the producing capacity of some very poor land to about three times what it had formerly been.

A COTTON FARM.

In Southampton County, Va., on the typical sandy land soil of the Coastal Plain, is located a farm which had been cropped in



FIG. 8.—More than a bale of cotton to the acre after growing cowpeas and plowing under one crop of crimson clover.

corn and cotton continuously until it became so unproductive that tenants refused to work it any longer. Figure 7 shows the extent to which the soil had been reduced in fertility.

It should be borne in mind that the conditions shown in figure 7 were brought about by an improper method of crop farming. Fertilizers were used liberally both on the corn and the cotton crops, but, in spite of this fact, crop yields could not be maintained by this system.

In 1902 the farm in this condition was purchased by the present owner. With a very limited amount of capital he at once set about improving the soil. Some of the fields were planted to cowpeas in the spring of the first year with an application of 250 pounds of acid

phosphate per acre. Where the growth was good the peas were cut for hay and where the growth was small the crop was allowed to remain standing. The following spring the cowpea fields were planted to cotton with an application of 200 pounds per acre of a 2-8-3 fertilizer. Crimson clover was sown in the cotton just after the first picking. The yield of cotton was one-third of a bale per acre.

During the fall of the first year some of the fields were sown to rye with a small application of acid phosphate. The rye crop was plowed under in May of the next spring and corn was planted without any fertilizer. Cowpeas were sown in the corn at the last cultivation. The yield of corn was about 20 bushels per acre.

From the operations of the first year was developed a two-year rotation as follows:

First year.....	Cotton with crimson clover.
Second year.....	Corn with cowpeas.

In this rotation cowpeas were sown in the corn at the last cultivation and the crimson clover was sown in the cotton either at the last cultivation or just after the first picking, depending on the moisture conditions of the soil. Enough of the cowpeas are picked by hand for seed each year and occasionally some for sale. After the first year, both the cowpeas and the crimson clover grew to better advantage. The fourth year of this rotation the yield of cotton was 570 pounds of lint, or a little over one bale per acre, and the yield of corn was about 40 bushels per acre. Figure 8 shows the appearance of the cotton crop after the fourth year.

A CONTRAST IN WHEAT.

Under the average conditions of the Coastal Plains section, wheat growing is not a profitable enterprise; especially is this true on the lighter, sandier soils. Some wheat is grown, however, but the yields are small. Figure 9 shows a 20-acre field of wheat in shock which yields only $8\frac{1}{2}$ bushels per acre.

The wheat crop shown in this picture is typical of the results obtained on farms of the region which are situated on the poorer types of land which has been exhausted from continuous and improper cropping. It is needless to say that under these conditions the organic matter of the soil has been reduced to a very low point. The wheat crop in this instance was sown after corn, which is the usual practice, and had an application of 300 pounds of acid phosphate per acre.

For the sake of contrast and to show what better methods will do an adjoining farm which has been made highly productive may be cited. These two farms are situated in Sussex County, Del. Figure 10 shows a 100-acre field of wheat on identically the same type of soil, the yield being 30 bushels per acre.

The wheat shown in figure 10 was sown in part on a red clover sod and in part after early potatoes. The potatoes of the previous year had been fertilized with 1,000 pounds per acre of 5-7-7 $\frac{1}{2}$ fer-



FIG. 9.—Wheat yielding but $8\frac{1}{2}$ bushels per acre does not pay in this section.

tilizer. The wheat itself had an application of 300 pounds of 3-7-7 $\frac{1}{2}$ fertilizer per acre. This farm furnishes a good illustration of the efficient use of fertilizers on light sandy soils where a special effort is made to keep up the organic matter in the soil. In many instances where truck crops or potatoes are grown this same plan can be carried out profitably.

ANOTHER DELAWARE FARM.

A farm in Kent County, Del., furnishes another excellent example of the possibility of building up run-down sandy land in the Coastal



FIG. 10.—Same type of land as shown in figure 9. Thirty bushels of wheat per acre after growing legumes and using a little fertilizer.

Plain region. When the present owner came into possession of this farm the yields of corn ranged from 12 to 15 bushels. It is of more than passing interest to know that on certain fields of this farm for the past 25 years the yields have been about 50 bushels of corn per acre. These results have been obtained on a soil made up of coarse sand with a subsoil of the same character.

The methods by which these results have been obtained are simple in the extreme and are likewise inexpensive. Corn has been grown continuously year after year. Each year crimson clover is sown in the corn at the last working. The following spring the crimson clover is cut for hay and the stubble plowed under in preparation for the next corn crop. Each corn crop receives an application of 250 pounds per acre of a fertilizer made up of equal parts of 14 per cent acid phosphate and kainit. The land is plowed about 6 or 7 inches deep, the corn is well tended, and no weeds are allowed to grow. As previously stated, the average yield of corn for the past 25 years has been about 50 bushels per acre. In addition to this an average of at least a ton of crimson clover per acre has been cut annually. While these yields are not extremely large, the fact that this sandy land has been built up by simple and practical methods and that the yields have been maintained for so long a period is a matter of great interest. Up to the present time there is no indication of these yields declining. This plan of cropping is being adopted quite generally in the community, but as yet the results do not extend over a sufficient number of years to tell what the final outcome will be.

The example of this farm furnishes a striking illustration of the building up of a poor sandy soil by the addition of organic matter and the judicious use of fertilizers while the soil was yielding a fair financial return each year by a continuous growing of crops. The fact that this soil has been built up by such simple methods and the yields maintained for so long a period teaches some valuable lessons for the region concerning fertility problems in general, and furnishes an example of the effectiveness of fertilizers in the presence of sufficient organic matter. The example is all the more remarkable because on this farm no lime and no manure has been applied and only comparatively small amounts of commercial fertilizer have been used. The main secret of this striking success in building up sandy soil and maintaining good yields is the fact that the cropping system is so arranged as to keep up the supply of nitrogen and organic matter to a point of fairly high efficiency. By such a system it is possible to build up some of the nearly depleted soils of the region and at the same time make them pay an income. These methods go a long way in meeting the problem presented by the combination of poor soil and low finances.

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